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The Process of Information Systems Architecture Development

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Abstract

The DoD Architecture Framework (DoDAF) provides the guidance and rules for developing, representing, and understanding architectures based on a common denominator across DoD, Joint, and multinational boundaries. In this paper, the process of DoDAF development is brought forward based the Activity-based Methodology (ABM). Information systems architecture development should consist of five steps, such as Planning and Design Phase, Operational Analysis Phase, Requirements Analysis Phase, Function Analysis Phase, Physical Synthesis Phase.

Keyword: DoDAF; Information Systems; architecture; ABM

1. Introduction

With the rapid development of information technology, all kinds of military information systems become increasingly complex, and the system developing has become increasingly difficult. In order to make the military information systems meet the needs of the army, it is necessary that the users, system analysts, system designers, system developers must work more closely with each other. However, due to different backgrounds, communication between the parties is very difficult, and easily brings about bias and errors. Ultimately, it leads that the system can not fully meet the needs of users. Architecture technology completely describes the architecture of the system from a different perspective, and it

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provides ideas and methods to solve the communication problem. Many institutions and personnel made a lot of different ways. Among them, the most mature is DoDAF that is put forward by U.S. Department of Defense. However, there are still a lot of problem, such as not understanding the development order, using the tools for view product issues incorrectly. It has caused confusion in the system architecture design and can not achieve the desired results of system architecture.

2. View and Product of DoDAF

Architecture is "the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time". It is "a defined area of the components of the structure, their mutual relations, and guide their design and the evolving principles and guidelines."

The DoDAF provides the guidance and rules for developing, representing, and understanding architectures based on a common denominator across DoD, Joint, and multinational boundaries. It provides insight for external stakeholders into how the DoD develops architectures. The DoDAF is intended to ensure that architecture descriptions can be compared and related across programs, mission areas, and, ultimately, the enterprise, thus, establishing the foundation for analyses that supports decision-making processes throughout the DoD. Now, there three versions are created by the Department of Defense. They are DoDAF 1.0, DoDAF 1.5, DoDAF 2.0 respectively. One of the most commonly used is version 1.5. In this paper, DoDAF is described and analyzed, giving an example for DoDAF 1.5.

2.1. View of DoDAF

The architecture framework is described from three Views including the Operational View, the Systems and Services View and the Technical Standards View. Among them, the Operational View describes the operational process in the command training scenes of the participating entities, activities and requirements; the Systems and Services View, for Legacy support, is the design for solutions articulating the Systems and Services, their composition, interconnectivity, and context providing for or supporting operational and capability functions; the Technical Standards View describes relevant standards. There is the All View on these there views. The All View describes the overarching aspects of architecture context that relate to all views. The information that links the Operational View, the Systems and Services View, and the Technical Standards View is shown in Fig 1. The three Views and their interrelationships driven – by common architecture data elements – provide the basis for deriving measures such as interoperability or performance, and for measuring the impact of the values of these metrics on operational mission and task effectiveness.

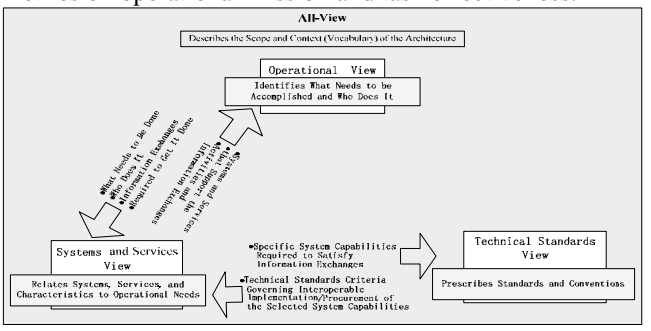

Fig. 1 Fundamental Linkages Among Views

2.2. Product of DoDAF

DoDAF views are formed by a number of products, which are described architecture by graphics, text or tables. Each product has a specific purpose, to illustrate a particular aspect of the architecture, and they are named through the form the view name (AV, OV, SV, TV) additional number. The name of each product, meaning can be found DoD Architecture Framework report. In Fig 2, the relationships between products are analyzed. Figure 2 (a) depicts the relationships between the Operational View products; Figure 2 (b) depicts the relationships between the Systems and Services View products.

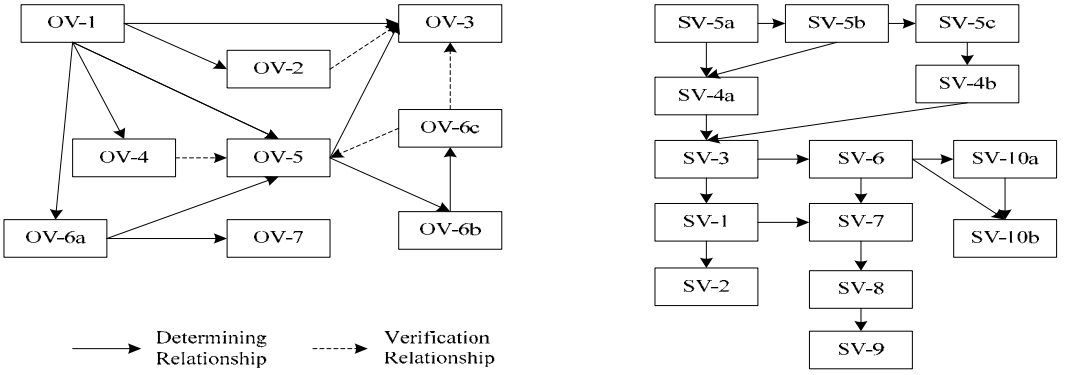

Fig .2 Relationships Between Products

3. Process of DoDAF Development

In the process of architecture development, three methods are often used. They are Structural Analysis Method (SAM), Object Oriented Design (OOD) and Activity-based Methodology (ABM). ABM describes the systems architecture through the "data-centric" idea, based the core entity object of architecture. So, ABM starts the activity, and has high flexibility.

In the report about DoDAF, the six-step development process for architecture framework, based ABM. The method described for the architects and architecture development team to provide a guide.

In this paper, the military information systems architecture is developed from five phases, based the ABM and Systems Engineering Approach (AEA). It is shown in the Fig 3. The figure shows the main activities of each stage and the formation of the architecture products.

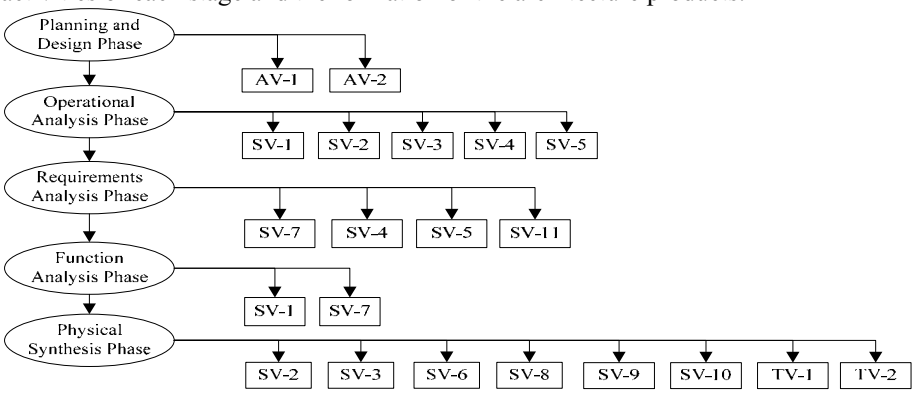

Fig. 3 Five-phase of Architecture Development

3.1. Planning and Design Phase

The main task of the first phase is to determine the intended use of the architecture, to determine the applications range, background, environment and other assumptions of architecture, to determine the characteristics which the architecture should have, and to determine view products and ancillary products that should be established. This corresponds to the first to the fourth step of "Department of Defense Architecture Framework". View products developed at this phase include:

AV-1: Overview and Summary Information
AV-2: Integrated Dictionary

3.2. Operational Analysis Phase

The main task of the second phase is to determine the agencies, behaviors, tasks and operational environment involved in the operational activities which the system is described. This phase describes the analysis, verification validation process for the operational requirements. View products developed at this phase include:

OV-1: High-Level Operational Concept Graphic
OV-2: Operational Node Connectivity Description
OV-3: Operational Information Exchange Matrix
OV-4: Organizational Relationships Chart
OV-5: Operational Activity Model
OV-6a: Operational Rules Model
OV-6b Operational State Transition Description
OV-6c: Operational Event-Trace Description

3.3. Requirements Analysis Phase

The main task of the second phase is to determine the system requirements to meet operational requirements. The military information systems can not solve all the needs of the operational requirements. Some of the operational requirements should be provided by the operational requirements document (ORD). Some of the operational requirements should be simplified. In addition, in this phase, the requirements of information exchange and information assurance should be nailed down, by identifying and optimizing requirements at all levels of cross-border flows of information systems. View products developed at this phase include:

OV-7: Logical Data Model
SV-4a: Systems Functionality Description
SV-4b: Services Functionality Description
SV-5a: Operational Activity to Systems Function Traceability Matrix
SV-5b: Operational Activity to Systems Traceability Matrix
SV-5c: Operational Activity to Services Traceability Matrix
SV-11: Physical Schema

3.4. Function Analysis Phase

In the fourth phase, the function which the system is provided with should be changed from the more abstract function to a series of lower-level functions, and the performance should be broken down a lot of

small performances. This phase can verify whether the design meets current operational needs. View products developed at this phase include:

SV-1: Systems Interface Description Services Interface Description

SV-7: Systems Performance Parameters Matrix Services Performance Parameters Matrix

3.5. Physical Synthesis Phase

The main task of the fifth phase is to determine the final stage of architectural composition. In this phase, how the functions of systems should be achieved is the central task. As the military information systems are large systems, composed of many subsystems, there may be many architecture plans which can be alternative. When the plans are selected, the locations of systems must be squared up. In other words, selection criteria are not fixed. It should be based on specific goals and needs to determine the availability of standards. View products developed at this phase include:

SV-2: Systems Communications Description Services Communications Description

SV-3: Systems-Systems Matrix Services-Systems Matrix Services-Services Matrix

SV-6: Systems Data Exchange Matrix Services Data Exchange Matrix

SV-10a: Systems Rules Model Services Rules Model

SV-10b: Systems State Transition Description Services State Transition Description

SV-10c: Systems Event-Trace Description Services Event-Trace Description

SV-8: Systems Evolution Description Services Evolution Description

SV-9: Systems Technology Forecast Services Technology Forecast

TV-1: Technical Standards Profile

TV-2: Technical Standards Forecast

4. Conclusions

Though some practice for development of military information systems architecture, the phases given above is available and rational. There is a need to explain that some view products can be bypassed in the development practice. But, the development process should also follow five phases.

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